Impervious Cover, Stream Health and the Prospects for Mitigation

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Chesapeake Stormwater Network

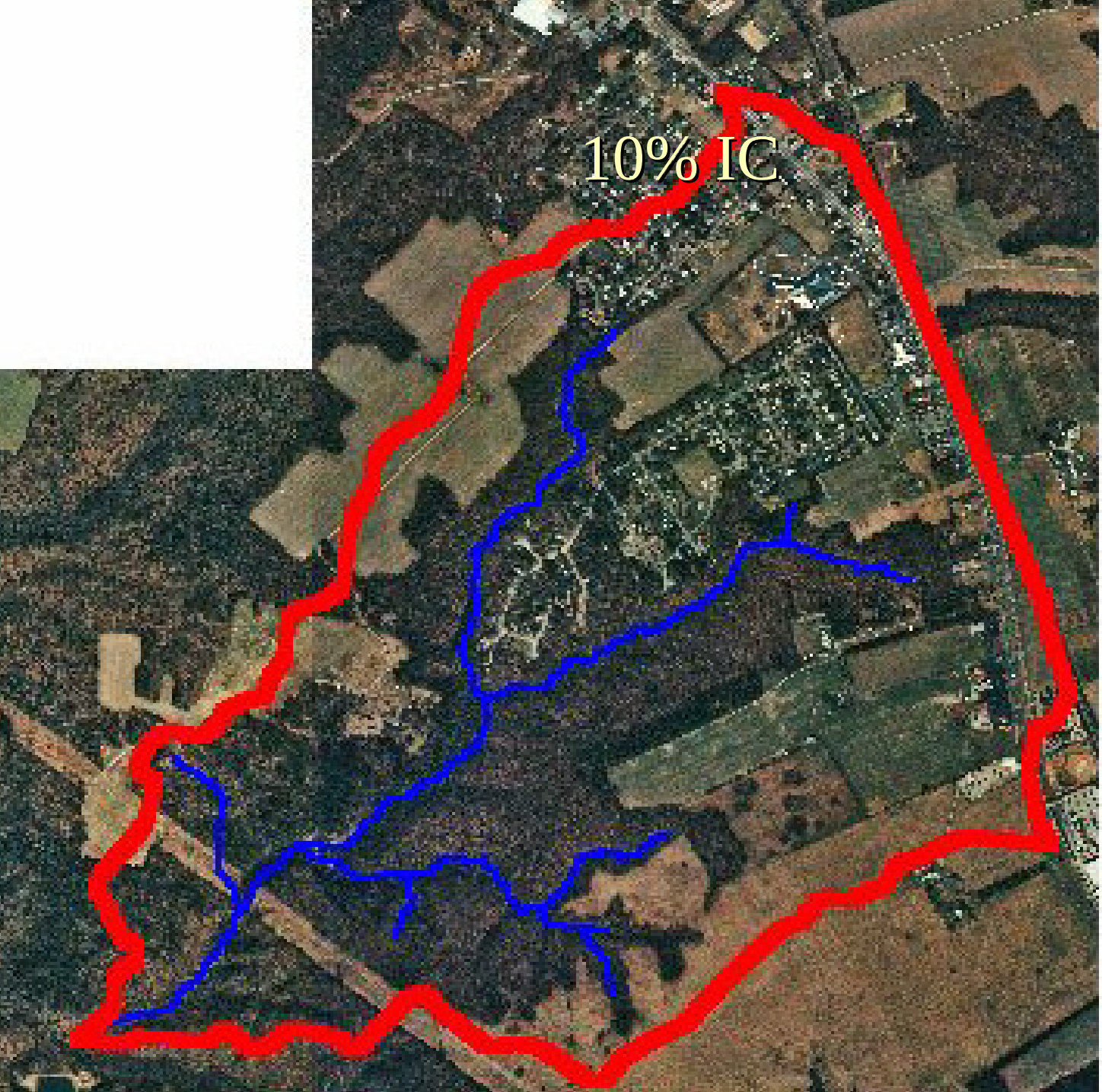
New organization launched in 2007 to improve on the ground implementation of effective stormwater practices in 1000 communities and 7 States in the Chesapeake Bay Watershed

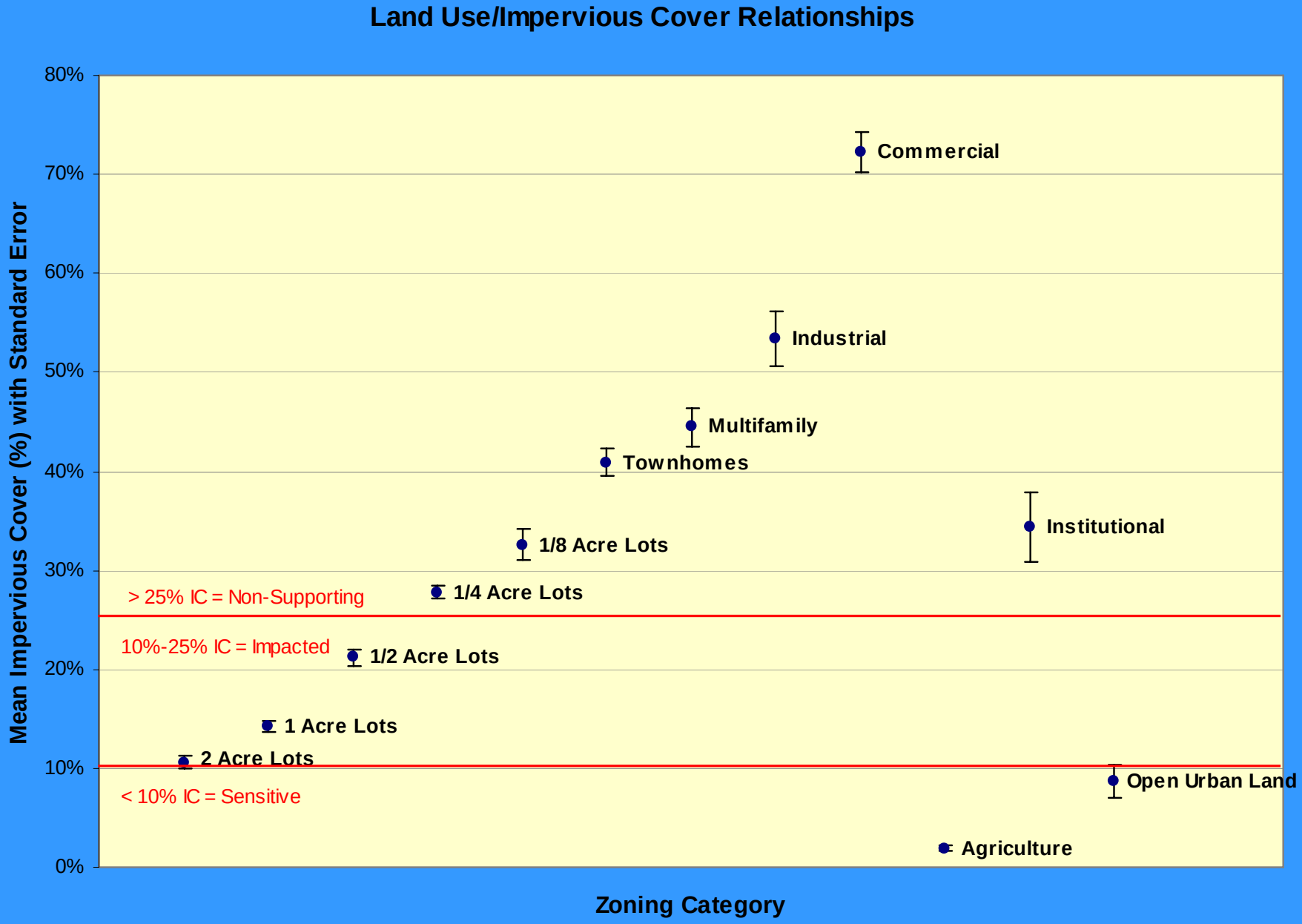
Creating alignment among the local, state, federal and private sectors to solve the Bay stormwater problem through an independent network of concerned stormwater professionals

www.chesapeakestormwater.net

Key Themes

- Impervious Cover and Stream Quality Research
- Is ESD to the MEP Enough?
- The Risks of Ten Mile Creek Becoming


10% IC


Land Use/Impervious Cover Relationships
Mean Impervious Cover (%) with Standard Error
80%
70%
60%
50%
40%
30%
20%
10%
0%
Commercial
Industrial
Multifamily
Townhomes
1/8 Acre Lots
Institutional
1/4 Acre Lots
> 25% IC = Non-Supporting
10%-25% IC = Impacted
1/2 Acre Lots
1 Acre Lots
2 Acre Lots
< 10% IC = Sensitive
Open Urban Land
Agriculture
Zoning Category

Total Impervious vs. Effective Cover

Total best at watershed scale, effective at site scale

The ICM Revisited: Recent Research

- 65 peer reviewed studies tested the ICM in wide range of ecoregions have been published since 2003

- 72% confirm or reinforce the ICM

- 28% are inconclusive or contradicting

- Contradicting studies are located in larger watersheds with legacy problems, and primarily involve dry weather water quality and baseflow

- Strongest support for aquatic insects, fish and individual geomorph. indicators

The ICM Revisited: Recent Research

Distribution of Database Entries With Regard to Freshwater Streams

Indicator	Total	Confirming	Reinforcing	Inconclusive	Contradicting
Hydrology [1]	4	0	0	1	3
Geomorphology	4	3	0	1	0
Habitat	7	3	1	0	3
Water Quality [2]	6	3	0	2	1
Benthic Macros	10	5	4	0	1
Fish	11	1	8	1	1
Composite [3]	2	2	0	0	0
Other [4]	5	1	1	2	1

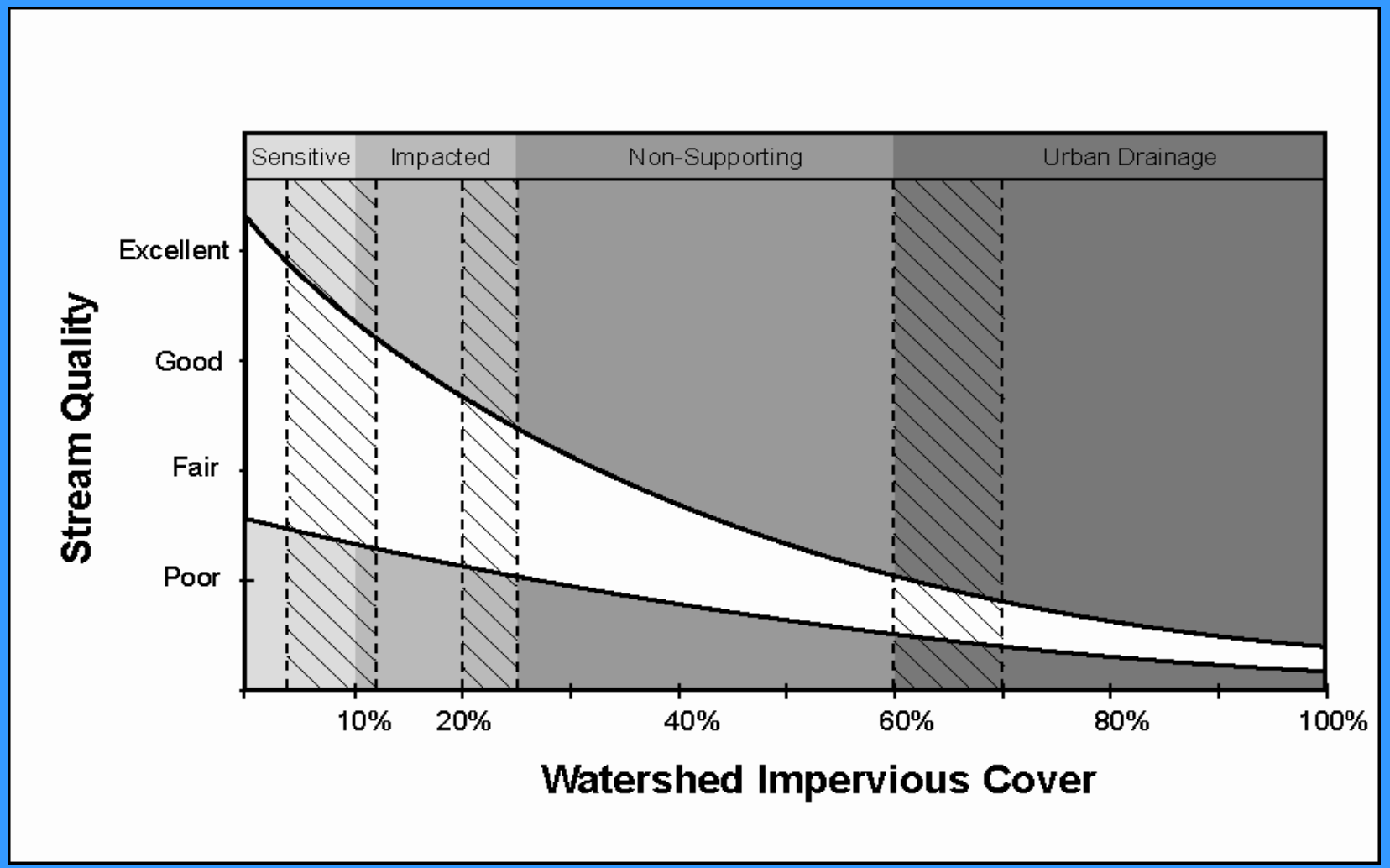
1 primarily baseflow

2 primarily water quality parameters sampled during dry weather, no studies evaluated stormflow quality

3 combined index measuring habitat, benthic macroinvertebrates and fish

4 other includes sediment quality, algae and amphibian abundance

The ICM and Urban Subwatershed Management

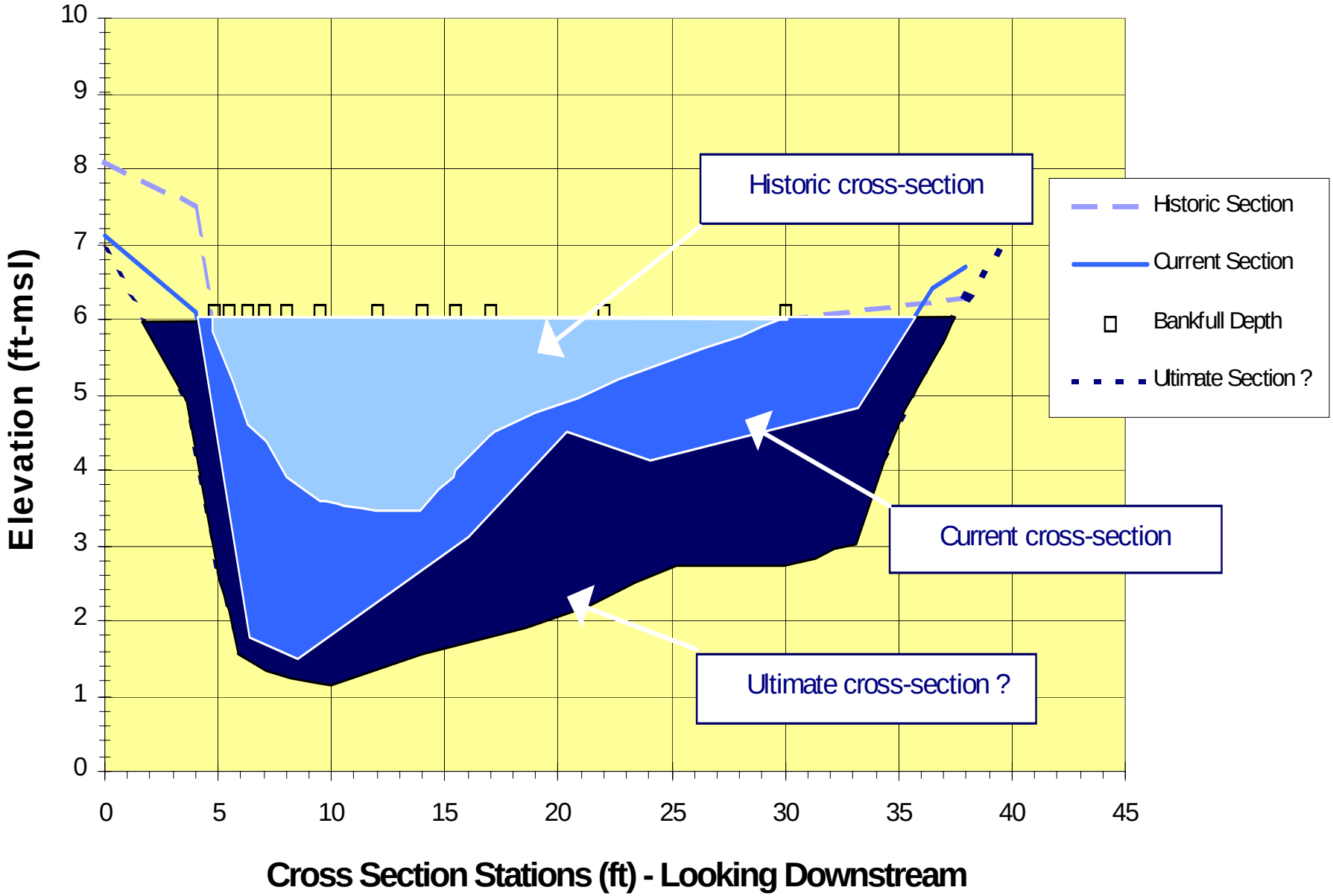


Why everyone hates the ICM

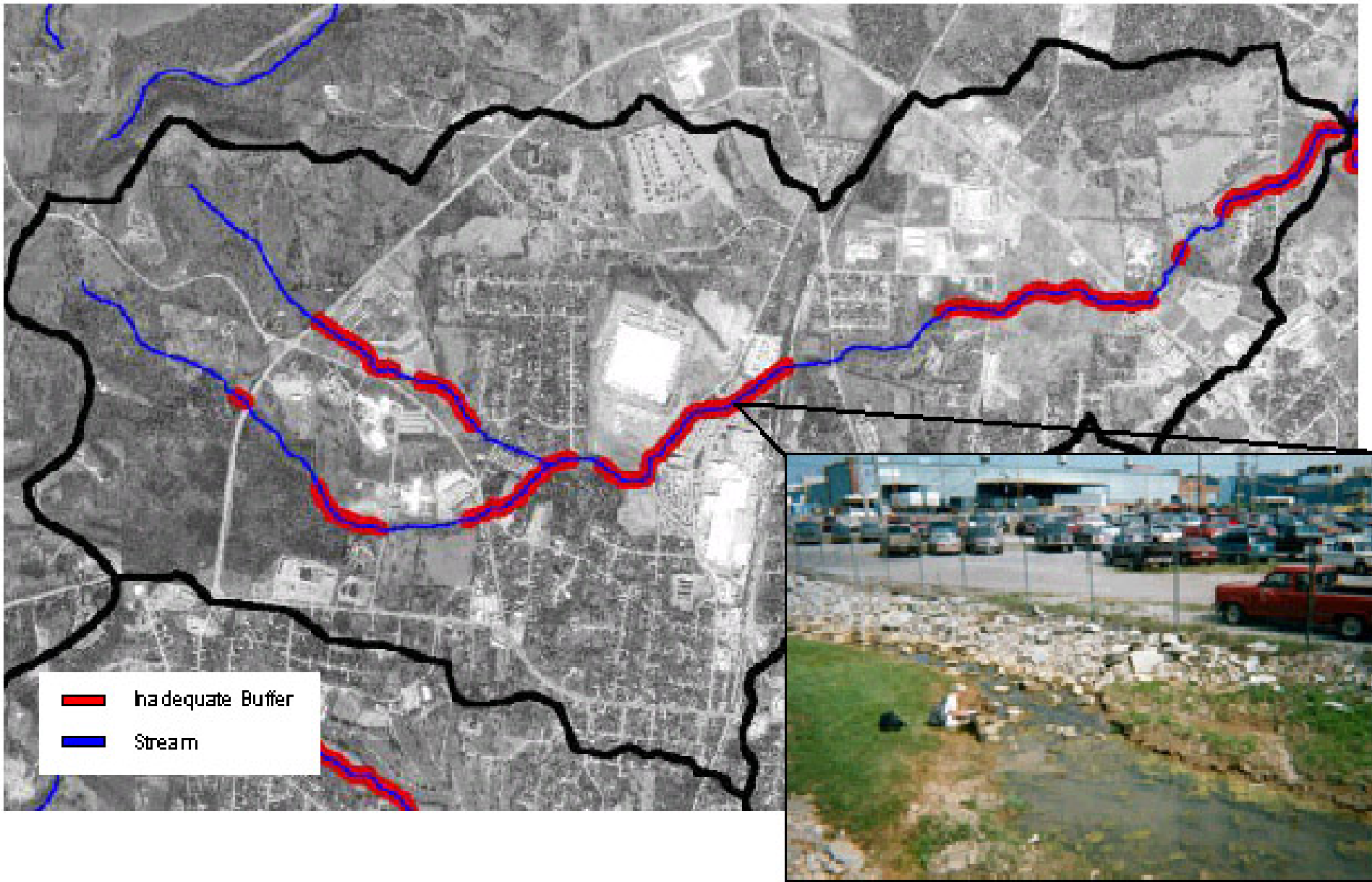
- Land use planners
- Smart growth advocates
- Water quality regulators
- Stormwater engineers
- Environmental activists
- Builders and developers
- Foresters and wetland experts
- Scientists
- Elected officials

IC also associated with:

Urban heat islands…vehicle pollutant emissions…PAH and metal levels in sediments….forest fragmentation….loss of streamside forest cover….Increased risks of stream interruption…illegal dumping and sewer overflows…bacteria sources….and many other factors


Elevation (ft-msl)
10
9
8
7
6
5
4
3
2
1
0
0
5
10
15
20
25
30
35
40
45
Cross Section Stations (ft) - Looking Downstream
Historic cross-section
Current cross-section
Ultimate cross-section ?
Historic Section
Current Section
Bankfull Depth
Ultimate Section ?

Loss of Riparian Buffer Continuity



Water quality indicators

- Violations of Bacteria standards
- Nutrients and eutrophication
- Aquatic life toxicity
- Sediment contamination
- Trash and debris loads

Caveats and Proper Use of the ICM

- Use should be restricted to 1st to 3rd order alluvial streams with no major point sources of pollutant discharge and no major impoundments or dams
- Stream slope, as measured across the subwatershed should be in the same range for all subwatersheds
- Management practices in the contributing watershed must be good (e.g. no deforestation, acid mine drainage, major point sources, intensive row crops, etc.)

Impacts are now detected well below the 10% IC threshold.

Impacts of land development are now detected as low as 5 to 8% impervious cover *

Research shows that metrics such as watershed forest, turf, wetland or riparian cover predict stream quality better below 10% IC

*** Sensitive taxa drop out at less then 2% IC**

Riparian forest buffers have a mitigating effect on the ICM

- Riparian forest cover appears to partly mitigate the effect of IC on streams, up to about 15% IC, especially for geomorphic and biodiversity indicators

- Beyond 15%, not much effect

- Subwatershed IC also related to loss of riparian quality

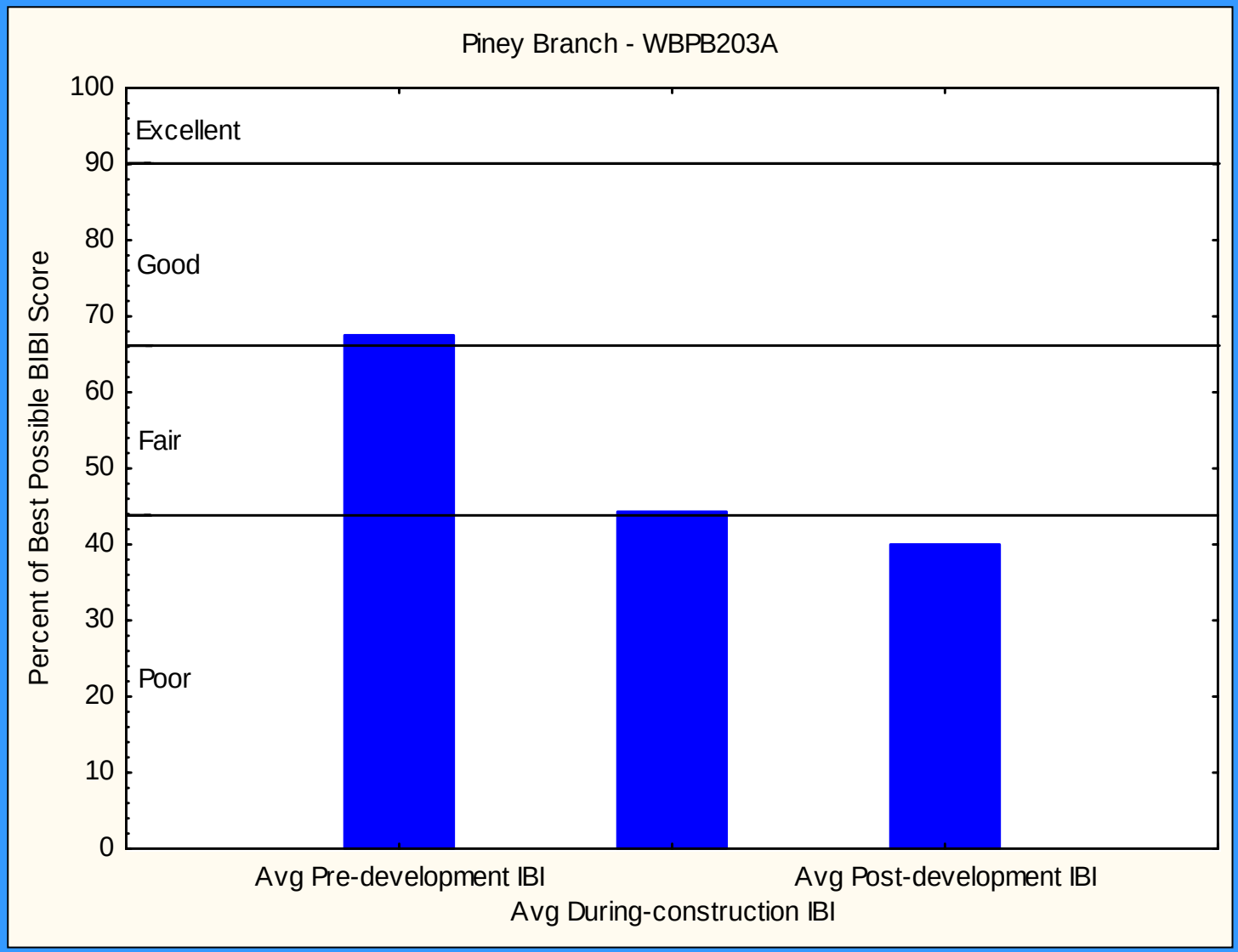
Not Much Effect From Current Watershed Treatment

- Most ICM research was done in regions with at least a moderate degree of development regulation

- The extent or effectiveness of watershed treatment has seldom been measured and is often incomplete

- Can show improvements within the limits of the reformulated ICM

The Initial effects of Construction



The Clipping Point: Emergence of Turf Cover As a Major Bay Ecosystem

TURF COVER, BAY WATERSHED 2000

Method 1: 3.82 million acres
Method 2: 3.79 million acres

TURF As PERCENT OF BAY LAND AREA

Method 1: 9.5%
Method 2: 9.5%

COMPARISON TO OTHER BAY LAND USES

Row Crops:	9.2% of watershed
Pasture:	7.7%
Hay and Alfalfa:	7.4%
Wetlands:	3.8%

Top Ten Turf Counties in Bay *

	Turf Acres	% of County
1. Montgomery County (MD)	140,000	(44%)
2. Baltimore County (MD)	136,500	(36%)
3. PG County, (MD)	121,000	(39%)
4. Lancaster (PA)	120,000	(20%)
5. Fairfax, VA (VA)	117,000	(46%)
6. York (PA)	111,000	(19%)
7. Frederick (MD)	96,000	(23%)
8. Anne Arundel (MD)	93,000	(36%)
9. Carroll (MD)	85,000	(30%)
10. Harford (MD)	77,000	(28%)

*Ten suburban counties comprise 10% of watershed area but produce 30% of all turf cover

IS ESD to the MEP Enough?

Probably not:

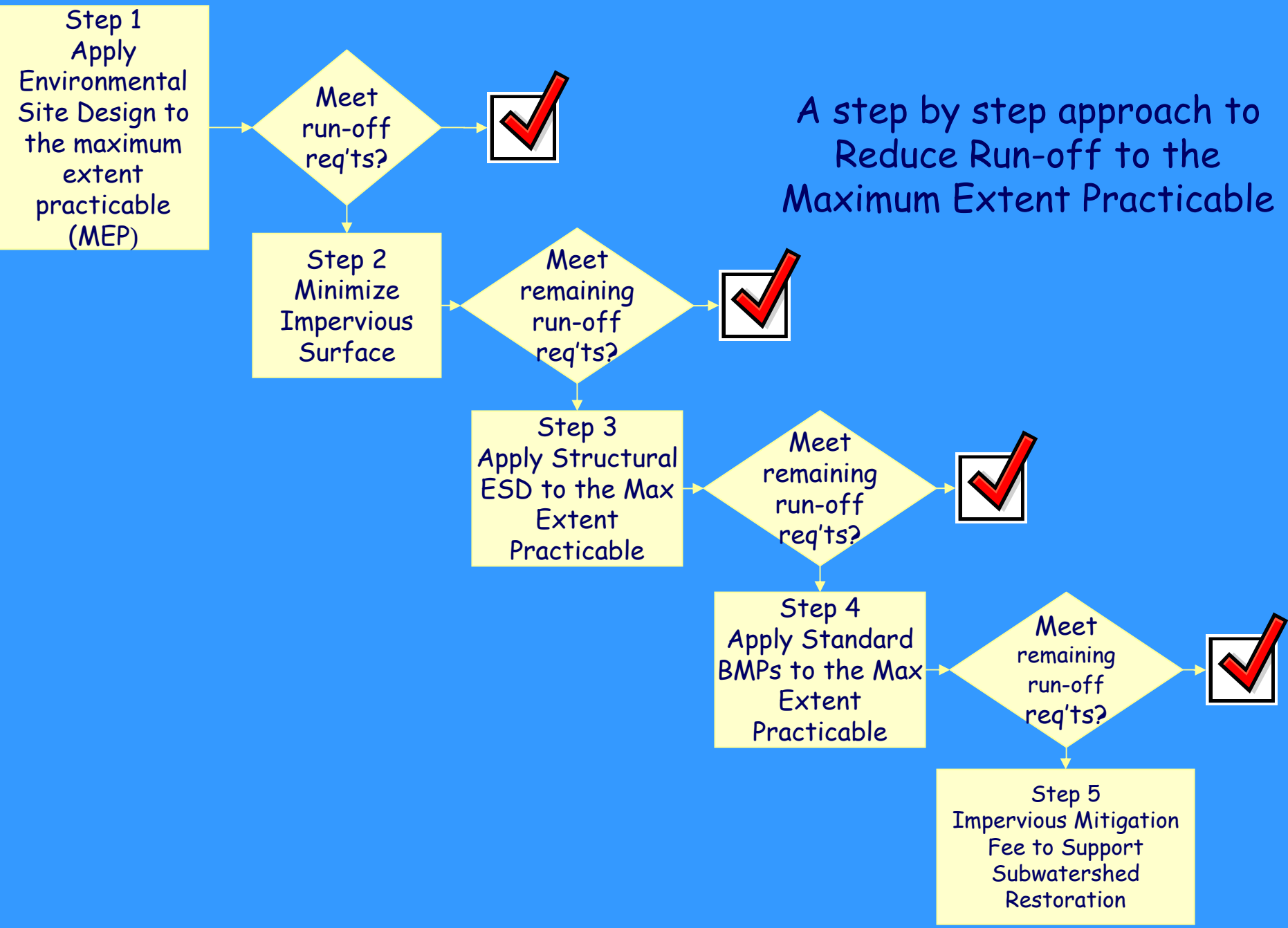
- For watersheds with more than 15% IC
- ESD does not always mean complete runoff reduction or pollutant removal
- Full ESD technically hard to achieve at sites
- Does not address turf vs. forest (soil compaction)
- Non-stormwater impacts not addressed (road salt, spills. leaks, overflows)
- Construction stage impacts are serious and hard to mitigate
- Invasive species and encroachment of the buffer
- Stream crossings

From the Roof to the Stream

1. Early ESD Site Assessment
2. Maximize Forest Canopy
3. Conserve Soils and Contours
4. Minimize Impervious Cover
5. Utilize Rooftop Runoff
6. Front Yard Bioretention
7. Dry Swales
8. Linear Wetlands
9. Stream Corridor Management

CSN (2008) Has Developed Compliance Method and Spreadshee

A step by step approach to Reduce Run-off to the Maximum Extent Practicable



Step 1 Compute Post-Development Land Cover

1. Post-Development Project & Land Cover Information

Constants

Annual Rainfall (inches)	43
Target Rainfall Event (inches)	1.00
Phosphorus EMC (mg/L)	0.28
Target Phosphorus Load (lb/acre/yr)	0.28
Pj	0.90

Land Cover (acres)

	A soils	B Soils	C Soils	D Soils	Totals
Forest/Open Space -- undisturbed, protected forest/open space or	0.0	2.0	4.0		6.0
Managed Turf -- disturbed, graded for yards or other turf to be		6.0	14.0		20.0
Impervious Cover (all soil types)	14.0				14.0
				Total	40.0

Rv Coefficients

	A soils	B Soils	C Soils	D Soils
Forest/Open Space	0.02	0.03	0.04	0.05
Managed Turf	0.15	0.20	0.22	0.25
Impervious Cover	0.95			

The 8 Tools of Watershed Protection

8. Watershed Stewardship

1. Watershed Planning

2. Land Conservation

7. Non-Stormwater Discharges

3. Aquatic Buffe

6. Stormwater Management

5. Erosion & Sediment Control

4. Better Site Design

Questions ?